Title: Capturing Polygons

Brief Overview:

The following lessons will focus on the attributes of polygons. The students will identify, illustrate, construct, sort, manipulate and classify various polygons. These lessons will help strengthen student's spatial sense, listening skills, and creativity. Before teaching these lessons students should have an understanding of angles and the names of polygons up to a 10-sided figure. Students should also be able to use a protractor for Day 2.

NCTM Content Standard:

Analyze characteristics and properties of two and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.

Grade/Level:

Grades 4-5

Duration/Length:

3 sessions, approximately 60 minutes each

Student Outcomes:

Students will:

- Compare and classify polygons based on their properties
- Construct polygons using geoboards
- Use protractors to measure angles of polygons

Materials and Resources:

- Student resource "Polygons Anticipation Guide"
- Teacher resource "Polygons Anticipation Guide Answer Key"
- Teacher resource "What Does Poly Like?"
- Student resource "Polygon Sort"
- Student resource "Quadrilateral Reteach Sheet"
- Student resource "Quadrilateral Assessment"
- Student resource "Right Triangle Cut-Outs"
- Teacher resource "Quadrilaterals Made for Triangles"
- Student resource "The Measuring Triangles Resource"
- Student resource "Polygon Vocabulary Cards"
- Student resource "Triangle Reteach"
- Student resource "Triangle Assessment Property Cards"
- Student resource "What Am I?"

- Student resource “Regular and Irregular Polygons”
- Teacher resource “Preparing Poly-Straws”
- Student resource “Capture the Polygons”
- Student resource “Capture Cards”
- Vocabulary cards
- Pattern blocks
- Scissors
- Pencils
- Sticky notes
- Chart paper
- Age appropriate children magazines
- Computer usage
- Glue/Tape
- Construction paper
- Property Cards

Development/Procedures:

Day 1

Pre-assessment

- Give students the student resource “Polygons Anticipation Guide.”
- Have students complete the “Before Column” of the anticipation guide and then collect the papers. At the end of Day 3 students should complete the “After Column” of the anticipation guide.

Engagement:

- Display a concept attainment chart on teacher resource “What Does Poly Like?”
- Discuss with students what Poly likes and what she does not like. The resource sheet is organized with polygons in the column of likes and non polygons in the column of dislikes.
- One row at a time, reveal to the students what Poly likes and does not like
- Have the students identify the differences between each figure.
- List in the third column why students think Poly likes the figure.
- Distribute student resource, “Polygon Sort.” Have the students classify their given shapes into two groups of what Poly would like and dislike.
- After the students have sorted their shapes tell the students that all the figures that Poly likes are called polygons.
- From the information the students provided on the “Concept Attainment Chart,” have the students give a definition of a polygon **(**Any closed plane/2D figure that is made up of line segments that meet to form end points).

Exploration

- Divide the students into five groups and provide each group with one of the five quadrilaterals (square, rectangle, parallelogram, rhombus, and trapezoid) and sticky notes.

Give students one silent minute to think about the properties of their quadrilateral individually. Then within their group, have them generate a list of properties that describe their quadrilateral. They should write a property on each sticky note. Instruct students to place sticky notes on the class quadrilateral chart paper. Encourage each student to place a sticky on the chart.

- As a whole class, sticky notes can be added or removed to fit each quadrilateral.

Explanation

- Review student responses
- Check for an accurate description of the quadrilateral properties. Ask the students using the thumbs up or down method whether they agree or disagree with each property. If the class is not in agreement concerning a specific property, place the sticky note to the side.
- Ask what all the shapes have in common? (4 straight sides)
- Ask the following focus questions to help the students recognize other properties they may be missing for the quadrilaterals:
    - What do you notice about the angles you see in each polygon?
    - What do you notice about the sides of the polygon? (Four sided, parallel sides etc.)
    - What do we call a four-sided polygon?
    - Which quadrilaterals have two pairs of parallel lines? What are some similarities between the quadrilaterals?
    - What are some of the benefits of learning the properties of quadrilaterals?
    - How can we use our understanding of quadrilaterals in a real life situation?
    - What are some professions that benefit from having the knowledge of quadrilaterals?

Application

- Give each student a geoboard with one rubber band attached to the board.
- Instruct the students to demonstrate a variety of quadrilaterals based on the different properties named in the previous activity. This will be a good opportunity discuss the similarities between squares and rectangles. At this point mention how all squares are rectangles, but not all rectangles are squares.

Differentiation

Reteach

Have students gather in a separate area of the classroom. Review the names of the polygons and the properties of each quadrilateral as a small group for reinforcement. Provide students with a picture card from student resource “Quadrilaterals Reteach” to have them identify the quadrilaterals they see in their picture. Once they have identified all of the quadrilaterals in their picture, students should list at least two properties of each quadrilateral that they have found. Students may use vocabulary cards to assist with identifying their shapes on their picture cards.

Enrich

Allow students to construct a poster showing where quadrilaterals can be found in the real-world. Students can make a collage using computer programs such as inspiration, Microsoft publisher, Google sketch, Google presentation, or use photographs and pictures from magazines. They are to include the properties of each quadrilateral, and tell how quadrilaterals and their properties are used in the real world.

Assessment

Distribute a Venn diagram, student resource "Quadrilateral Assessment" to each student. Have each student choose two quadrilaterals to compare by finding the similarities and differences for the shapes. Provide a word bank and quadrilaterals for those students who need further assistance.

Day 2

Engagement:

- Give each student a copy of student resource "Right Triangle Cut-Outs."
- Students should cut out all of their triangles
- Direct the students to create as many quadrilaterals as they can using four triangles
- Students should be able to make at least 5 different quadrilaterals utilizing four triangles.
- Make sure that your students understand that they only need 4 triangles to construct at least 5 of the quadrilaterals. See student resource "Quadrilaterals Made from Triangles Resource."

Exploration

- Distribute student resource "Triangle Property cards for "I Have…"
- Place the six "I Have…" Triangle Display Cards around the room.
- Students will choose to stand underneath the triangle card that best matches their property.

Explanation

- Ask several students why they chose to stand under their particular triangle.
- Ask if anyone thinks their property belongs to another triangle. Through discussion students will discover that their property could be suitable for more than one triangle.
- Students should then place their property card beneath the correct triangle card they believe it matches.
- Then ask if anyone sees a property that does not belong with a particular triangle? Why?

Based on the properties, students should create a definition of each triangle. These definitions will be based on the property cards the students posted around the triangle card area. Reinforce the fact that the sum of all three angles in a triangle equal 180 degrees, For example, what properties does an isosceles triangle have?

Application

- Have students take out their triangle vocabulary cards. They should cut and assemble vocabulary cards by stapling them into a booklet
- Distribute 6 triangles from student resource "The Measuring Triangles Resource Sheet" a straight edge ruler, and a protractor to each student.
- Using the triangle vocabulary cards from student resource "Polygon Vocabulary Cards" to guide them, students will choose three of the six triangles. Instruct students to measure all the angles in order to classify them correctly.
- After measuring the angles, students should label the measured angle on each of the three triangles they choose.

- Students should then take the remaining 3 triangles and based on the description of their sides, classify the remaining triangles. Students will need the straight edge ruler for this activity in order to measure the sides.
- During this time observe the students' work. Begin noting the students who will need further assistance (Reteach) and those that will need an extension to the activity (Enrich).

Differentiation

Reteach

- Give the students student resource "Triangle Reteach Resource"
- Review the directions with the small group.
- Complete the first one together.
- Students will then complete the rest on their own or with another student in the reteach group.
- Review the answers when students are finished.

Enrich

- Divide students into an even number of small groups.
- Each group should create five questions about triangles.
- These questions should be written on index cards.
- Once each group has their questions they should link with another group to play their game.
- Each group will take turns reading their questions for the other group to answer.
- The team with the most points wins.

Assessment

- Create two property piles, one focused on sides and the other focused on angles using student resource "Triangle Assessment Property Cards."
- Students will choose randomly one property from each pile.
- Using the properties they choose, students should illustrate the triangle.
- Allow students who need reteaching to choose two properties that illustrate their triangle. Make the random choice optional.

Day 3

Engagement:

- Use student resource "What Am I?" and tape a polygon or the name of a polygon on the back of each student
- Explain to the students that they will walk around and ask their classmates one yes or no question at a time about an attribute of the polygon taped on their back. (For example, Does my polygon have four angles?) From the answers they receive, students should be able to guess what polygon they have taped on their back.

Exploration

- Give students a copy of student resource "Regular and Irregular Polygons."
- Have students cut out the six polygons. Then sort the shapes into a regular polygon pile and an irregular polygon pile.
- Once shapes are sorted, students should write why they think the shapes in the regular pile are regular, and why the shapes in the irregular pile are irregular.

Explanation

- Take several responses from the students as to why they believe their pile is regular and why their other pile is irregular.
- Post the definition of regular polygons and irregular polygons using teacher resource "Regular Polygons and Irregular Polygons" and discuss the similarities and differences.
- After discussing the definitions ask students if they would make any changes to their piles and why.

Application

- From the discussion and definitions of regular and irregular polygons, students will construct additional regular and irregular polygons out of straws.
- Refer to teacher resource "Preparing Poly-Straws" to pre-make the different types of straws the students will use;
- Students will work in pairs to use these straws to construct three regular and three irregular polygons
- The students will use these regular and irregular polygons to identify the properties of each polygon.

Differentiation

Reteach

- Collect samples of the students' polygon straw constructions.
- Display one of the constructions and ask the students, "Does this polygon have sides that are all the same length?" Sort the shapes into piles of regular and irregular polygons.

Enrich

Students will play "*Capture the Polygons*" Using student resources "Capture the Polygons" and "Capture Cards."

Assessment
Redistribute the student resource "Polygon Anticipation Guide." Students will use their knowledge to complete the "After" section of the guide.

Summative Assessment:
The students will use their knowledge about polygons to answer questions on the student resource "Poly Assessment." Use the answer key to assess student understanding.

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Polygons Anticipation Guide
(Pre-Assessment)

Directions: Read each statement below, and write TRUE or FALSE in the ***before*** column. Once you have learned about the concepts, you will then write TRUE or FALSE in the ***after*** column.

BEFORE	STATEMENTS	AFTER
	1. All quadrilaterals have four straight sides.	
	2. A heptagon has more sides than a nonagon.	
	3. A rectangle is a square, but a square is not a rectangle.	
	4. A rhombus is a parallelogram that has all equal sides.	
	5. A polygon is a closed plane (2D) figure that is made up of line segments that meet to form endpoints.	
	6. A scalene triangle is a triangle that has two sides that are the same length.	
	7. A rectangle is a parallelogram.	
	8. Right triangles have all right angles.	
	9. The angles of a quadrilateral equal 180 degrees.	
	10. A pentagon is a five-sided polygon.	

Name _____

Polygons Anticipation Guide Answer Key

STATEMENTS	ANSWER
1. All quadrilaterals have four straight sides.	True
2. A heptagon has more sides than a nonagon.	False
3. A rectangle is a square, but a square is not a rectangle.	False
4. A rhombus is a parallelogram that has all equal sides.	True
5. A polygon is a closed plane figure that is made up of line segments that meet to form endpoints	True
6. A scalene triangle is a triangle that has two sides that are the same length.	False
7. A rectangle is a parallelogram.	True
8. Right triangles have all right angles.	False
9. The angles of a quadrilateral equal 180 degrees.	False
10. A pentagon is a five-sided polygon.	True

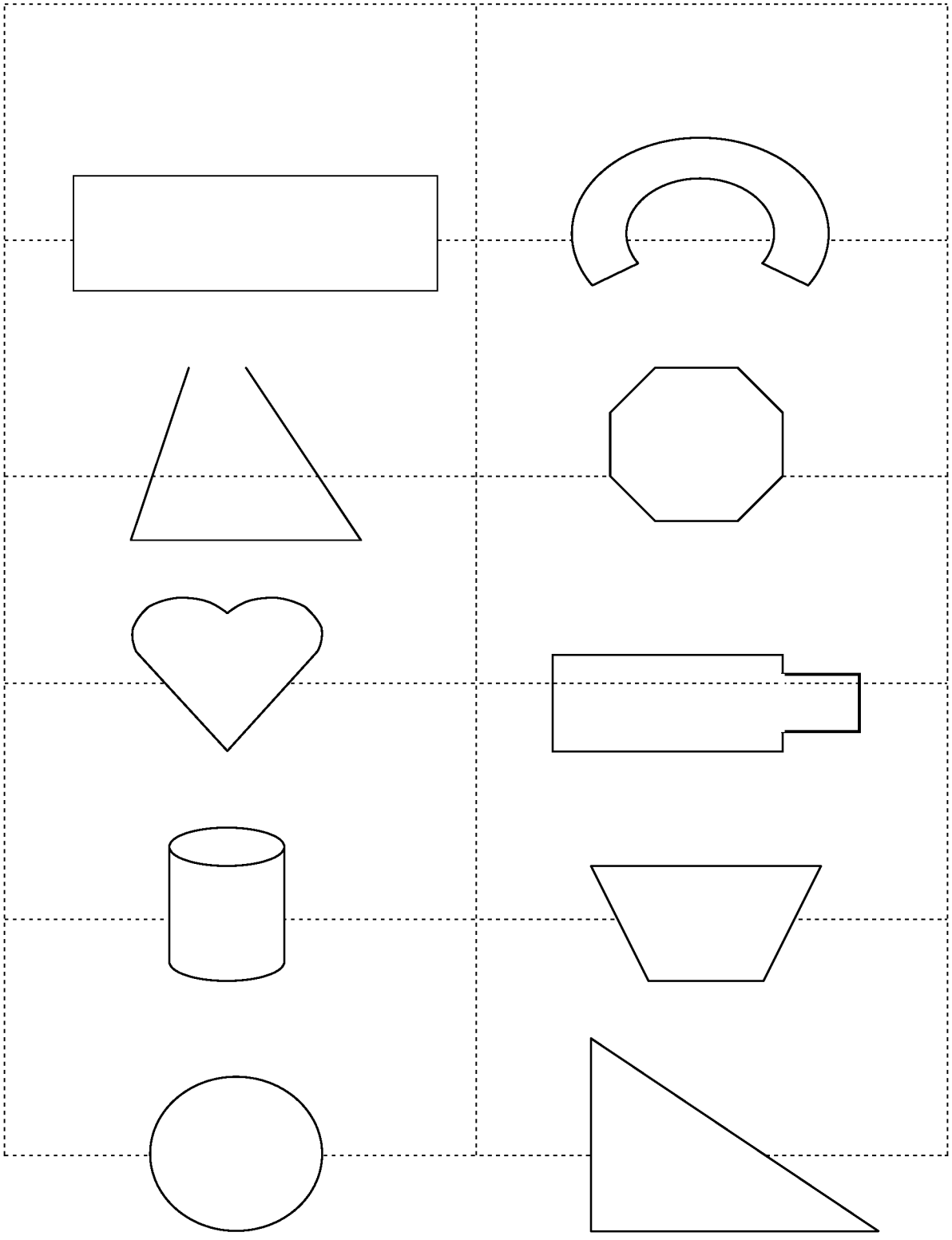
Geoboard Quadrilaterals

Say the following statements as students display this on their geoboards.

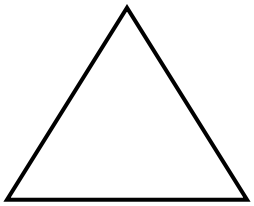
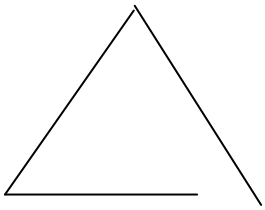
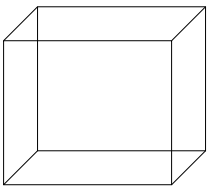
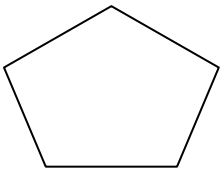
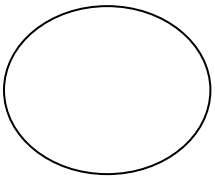
"This quadrilateral has…"

1. 4 sides and 4 right angles
2. 4 equal sides
3. 4 unequal sides and no right angles
4. 4 sides with exactly 2 parallel sides
5. 4 sides with 2 pairs of parallel sides
6. 4 sides with exactly 1 pair of perpendicular sides
7. 4 sides with 2 pairs of perpendicular sides
8. 4 sides with NO sides that are parallel
9. 4 sides with NO sides that are perpendicular
10. exactly 2 right angles

Polygon Sort Student Resource

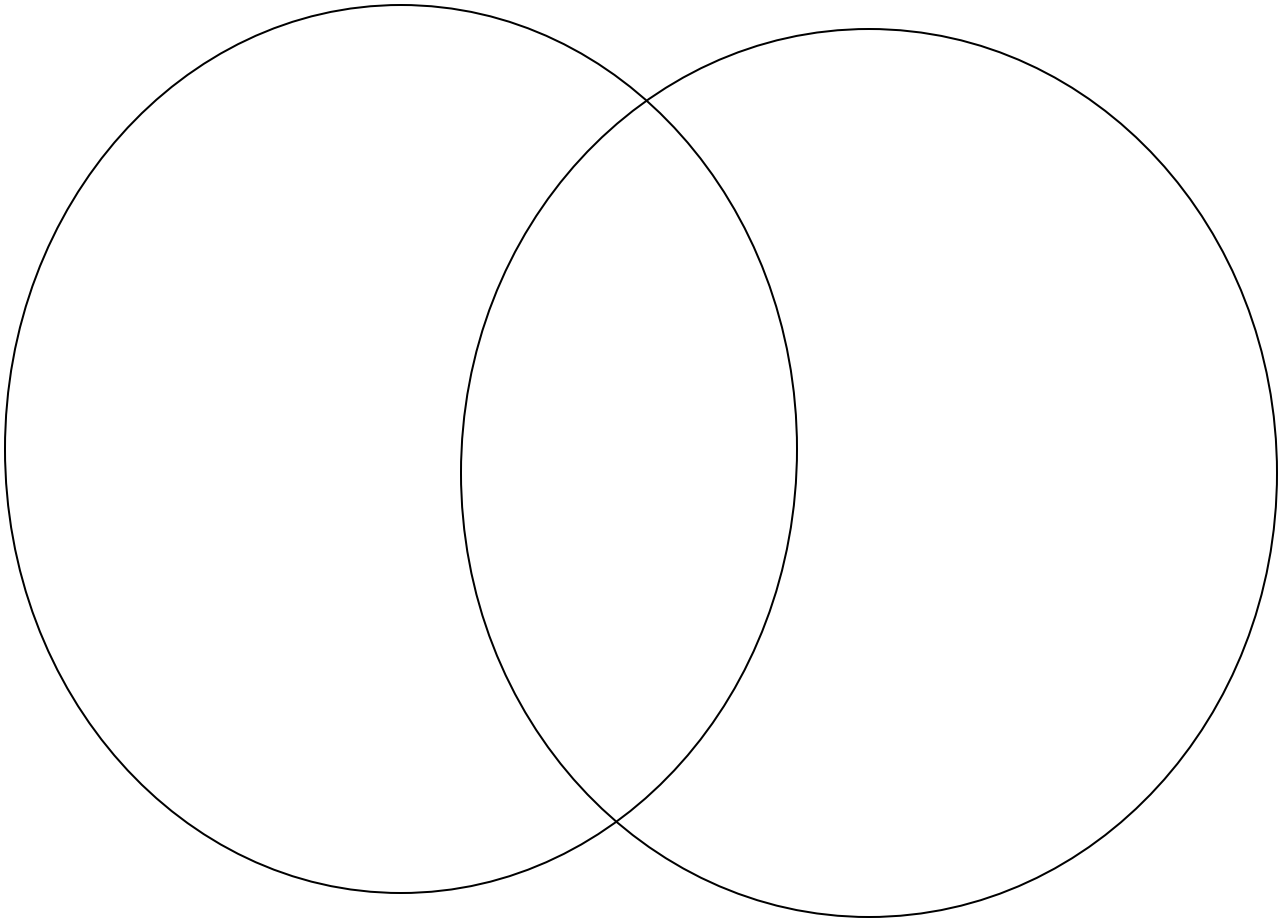


What Does Poly Like?

Poly likes…	Poly does not like…	Why does Poly like this?
		
		
		

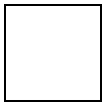
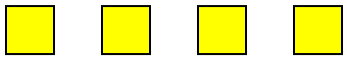
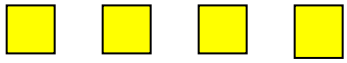
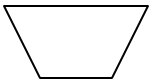
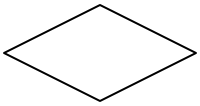
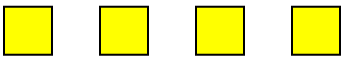
Answers: Closed figure, 2D or plane figure, All straight sides

Quadrilateral Assessment



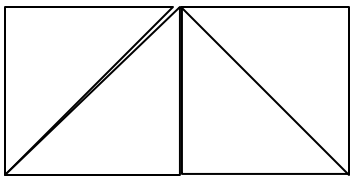
Word Bank

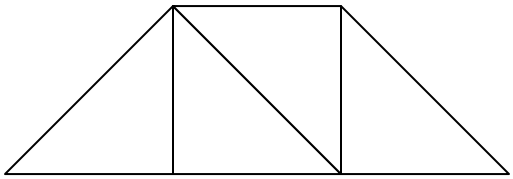
Quadrilateral Property Reference Sheet

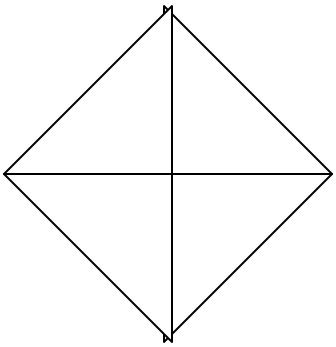
	Quadrilaterals	**Properties**
Square		
Rectangle		
Trapezoid		
Parallelogram		
Rhombus		

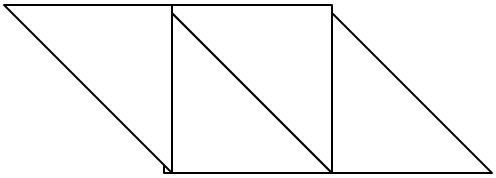
Quadrilaterals Made from Triangles

Below are the possible quadrilaterals students can make with their four right triangles.

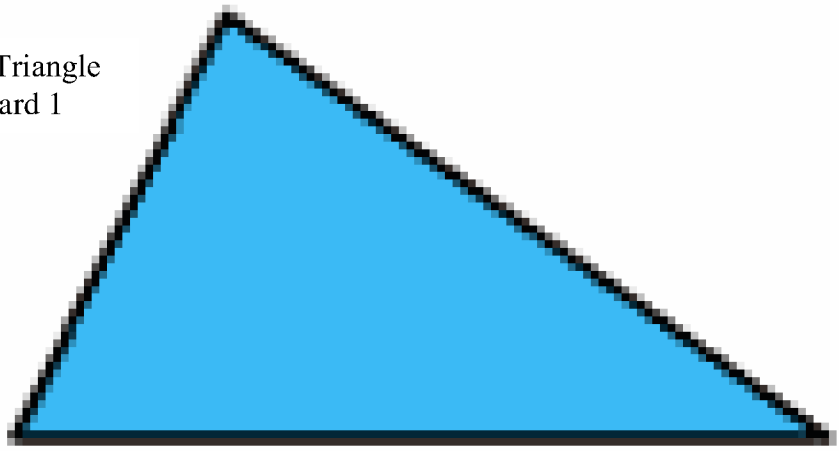




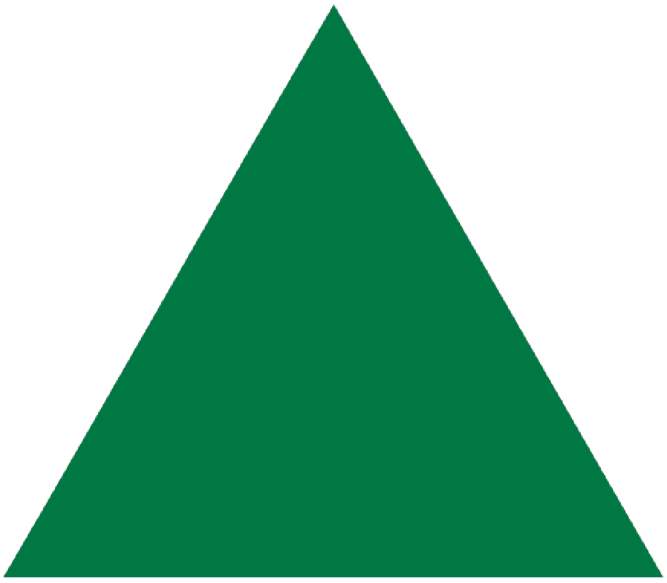




"I Have" Triangle
Display Card 1



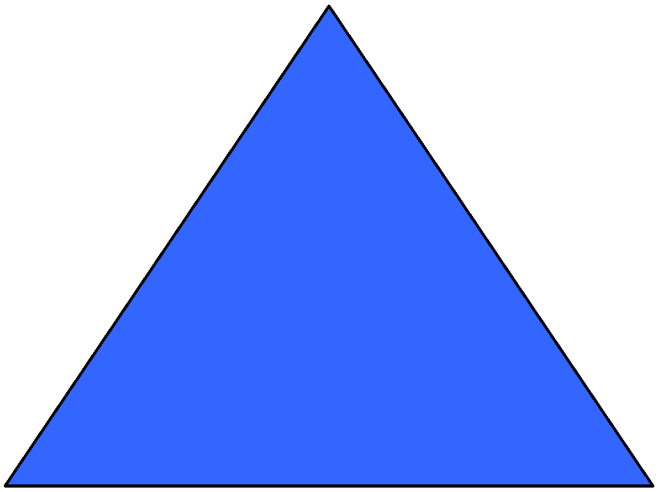
Scalene Triangle



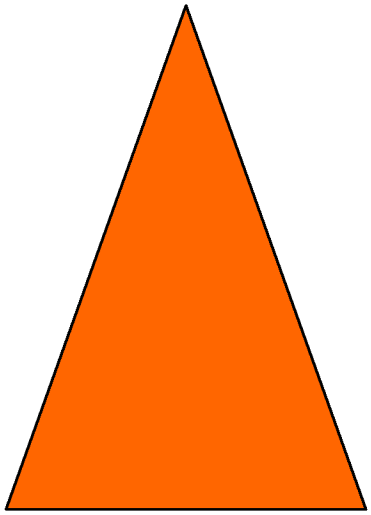
Equilateral Triangle

Equilateral Triangle

"I Have" Triangle
Display Card 2

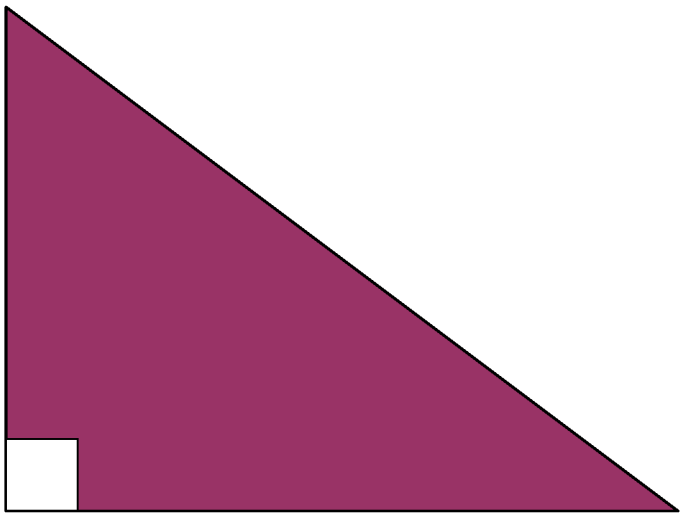


Acute Triangle

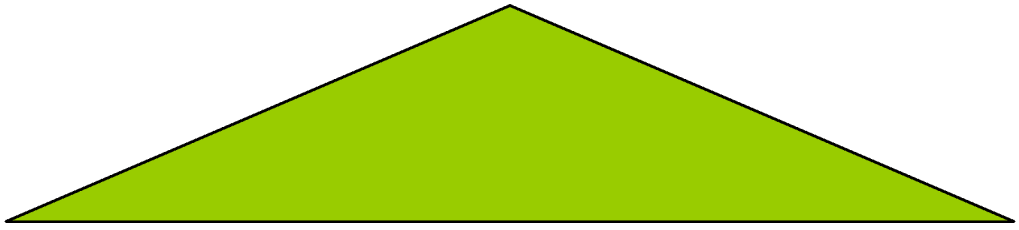


Isosceles Triangle

"I Have" Triangle
Display Card 3



Right Triangle



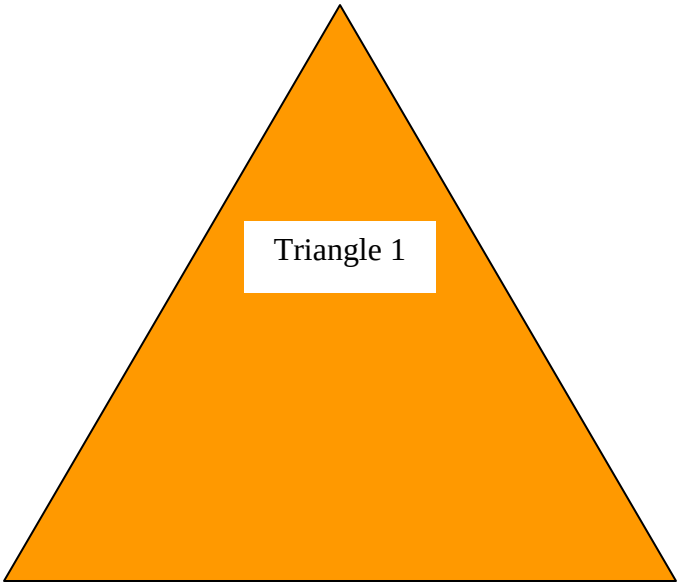
Obtuse Triangle

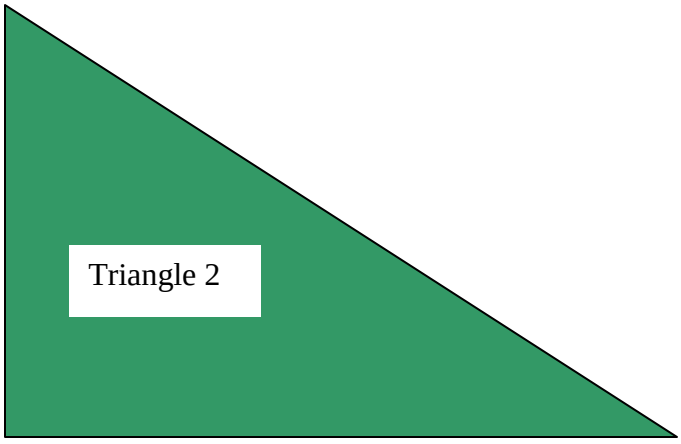
Triangle Property Cards for "I Have"

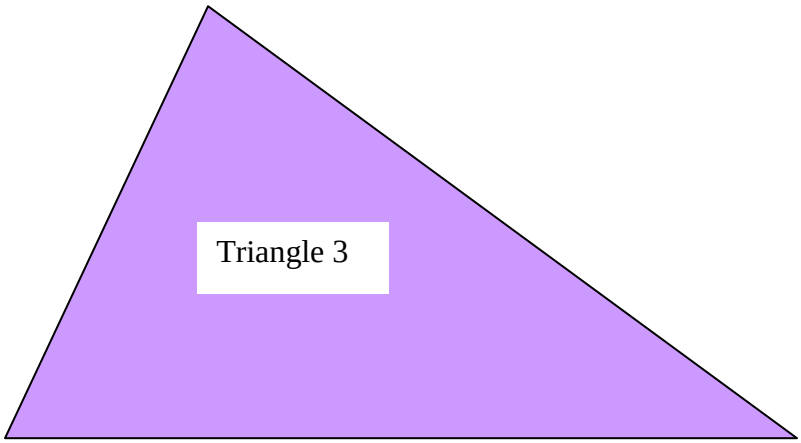
Note: Multiple copies can be made for this activity. It is ok for students to have the same clue, because they may choose a different triangle and still be correct.

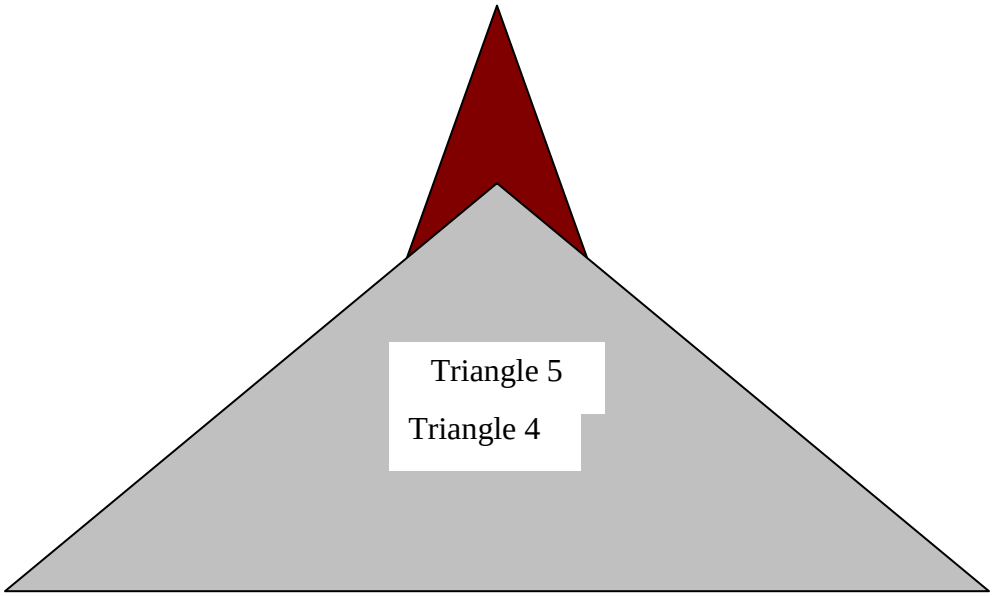
I have at least TWO ACUTE ANGLES
I have a RIGHT ANGLE
I have an OBTUSE ANGLE
TWO of my SIDES ARE THE SAME LENGTH
NONE of my SIDES ARE THE SAME LENGTH
ALL of my SIDES ARE THE SAME LENGTH
I have EXACTLY TWO ACUTE ANGLES
I have THREE ACUTE ANGLES
I have EXACTLY TWO ACUTE ANGLES AND TWO SIDES THAT ARE THE SAME LENGTH
I have TWO SIDES OF THE SAME LENGTH, BUT DO NOT HAVE ALL ACUTE ANGLES
I have an ANGLE THAT MEASURES 90 DEGREES

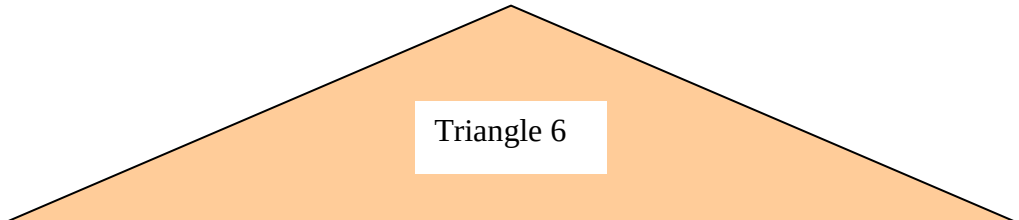
Measuring Triangles






Triangle 3

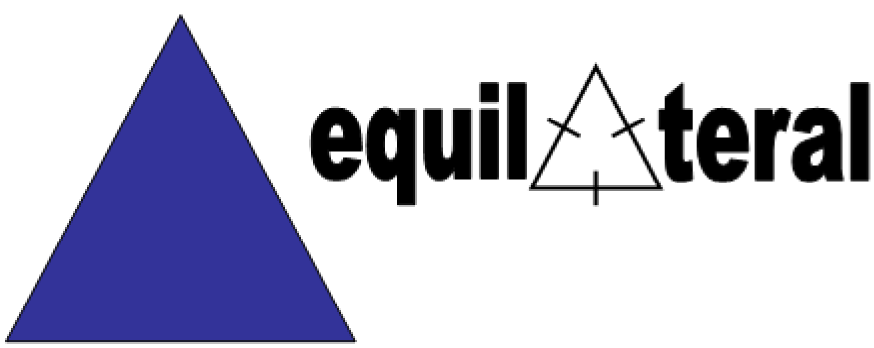

Triangle 5
Triangle 4


Triangle 6

Polygon Vocabulary Cards

Equilateral Triangle

A triangle with all sides the same length

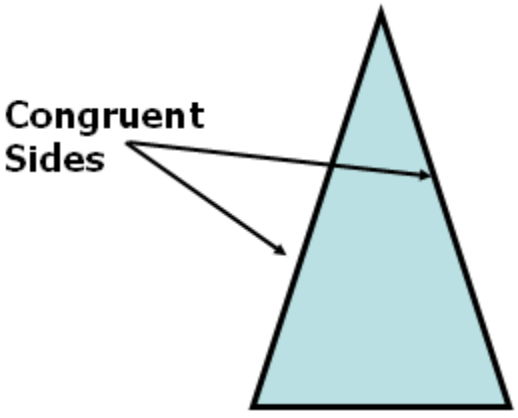


Hexagon

A polygon with 6 sides

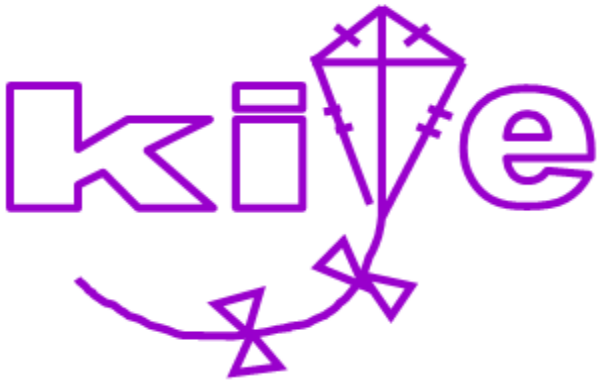
Isosceles Triangle

A triangle that has two congruent sides



Kite

A quadrilateral with two pairs of adjacent congruent sides



Parallelogram

A quadrilateral with two pairs of parallel and congruent sides

Pentagon

A polygon with 5 sides

Plane

A flat surface that extends infinitely in all directions

Polygon

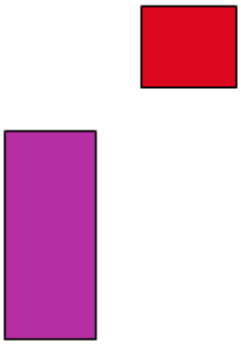
A closed plane figure formed from line segments that meet only at their endpoints

Quadrilateral

A polygon with 4 sides

Rectangle

A quadrilateral with two pairs of congruent, parallel sides and four right angles

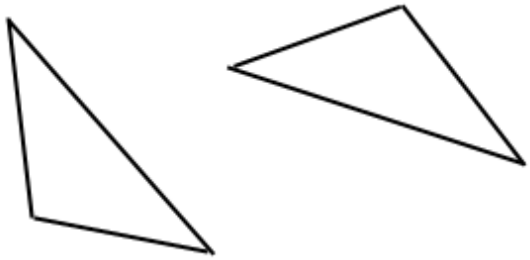


Rhombus

A parallelogram with all 4 sides equal in length

Scalene Triangle

A triangle that has no congruent sides

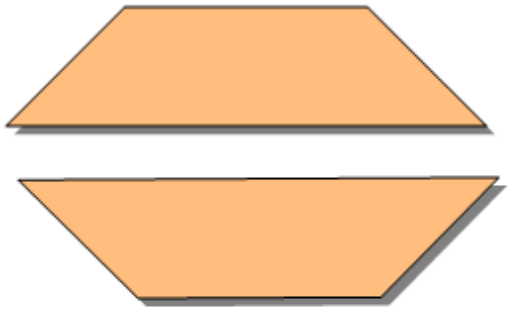


Square

A parallelogram with 4 congruent sides and 4 right angles

Trapezoid

A quadrilateral with exactly two parallel lines

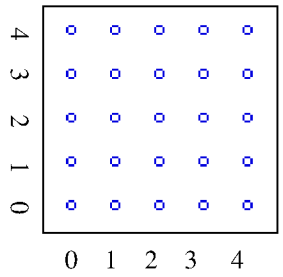


Triangle

A polygon with three angles and three sides
("tri" means 3)

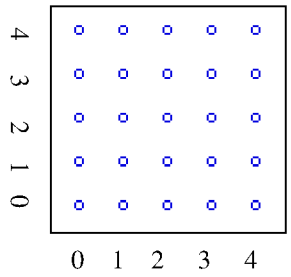
Triangle Reteach

Name _____



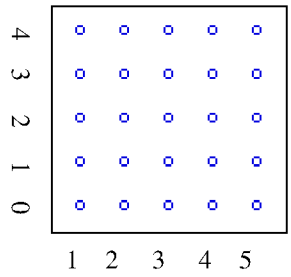
1. (2,2) (3,4) (4,2)

Scalene
Isosceles
Equilateral



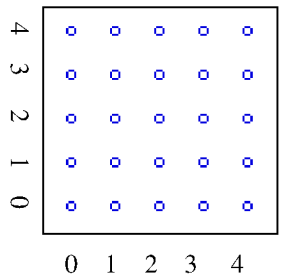
2. (1,1) (2,4) (3,1)

Scalene
Isosceles
Equilateral



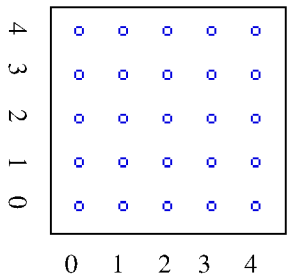
3. (1,1) 2,1) (3,3)

Scalene
Isosceles
Equilateral



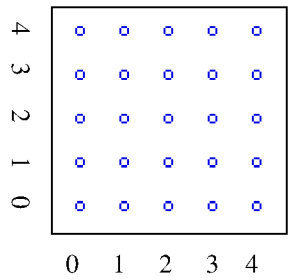
4. (0,2) (2,3) (4,1)

Acute
Obtuse
Right



5. (1,1) (3,1) (3,3)

Acute
Obtuse
Right



6. (1,3) (2,4) (3,3)

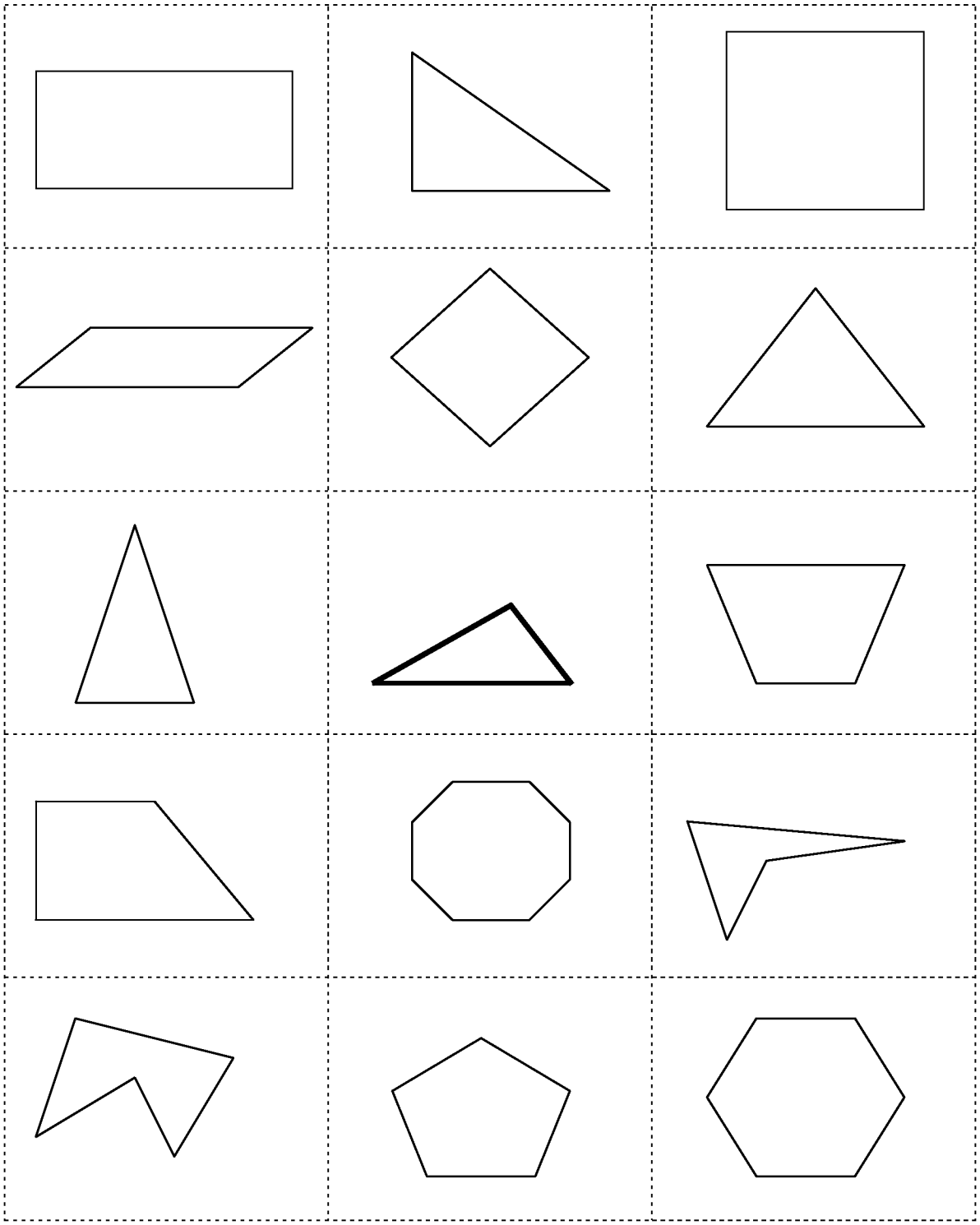
Acute
Obtuse
Right

Triangle Assessment Property Cards

All sides are the same length
Two sides are the same length
No sides are the same length
One right angle
One obtuse angle
All acute angles

What Am I?

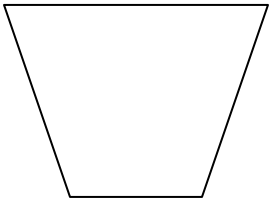
Cut the following shapes and word names to place on students' backs.

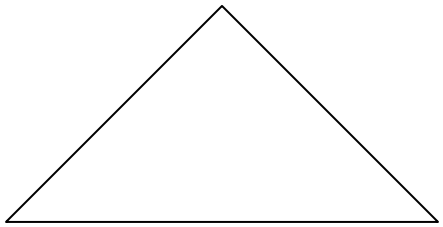


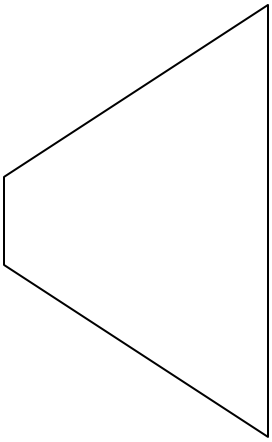
What Am I?

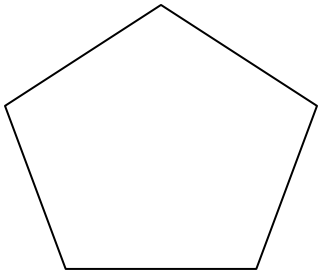
RECTANGLE	RIGHT TRIANGLE	SQUARE
PARALLELOGRAM	RHOMBUS	EQUILATERAL TRIANGLE
ISOSCELES TRIANGLE	SCALENE TRIANGLE	TRAPEZOID
TRAPEZOID	OCTAGON	IRREGULAR QUADRILATERAL
IRREGULAR PENTAGON	REGULAR PENTAGON	HEXAGON

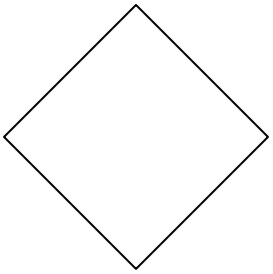
Regular and Irregular Polygons











Preparing Poly-Straws

- Using a bag of Flexible Straws (preferably the four colored pack), each student will need 15 straws of each color.
- Each color will be cut to the following sizes:
    - Red- Do not cut.
    - Blue- Cut ½ of each straw measuring from the bottom to the flexible point of the straw.
    - Green-Cut 1/3 of each straw measuring from the bottom to the flexible point of the straw.
    - Yellow- Cut ¼ of each straw measuring from the bottom to the flexible point of the straw.

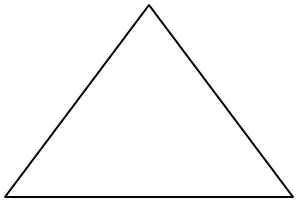
- Once all straws are cut, use the scissors to cut down from the top of the straw to the flexible point of the straw.
- Place each set of straws in a bag.
- Once all straws are cut, use the scissors to cut from the top of the straw to the flexible point of the straw. This will allow proper connection of the straws.

How to use of the Poly Straws

- To use the Poly Straws insert the large end of the straw into the smaller end of the straw.

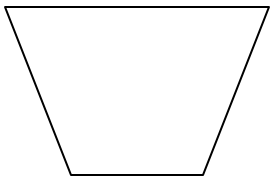
Regular Polygons

A regular polygon is a polygon in which the sides are all the same length and are symmetrically placed about a common center. Example: The polygon is both equiangular and equilateral.

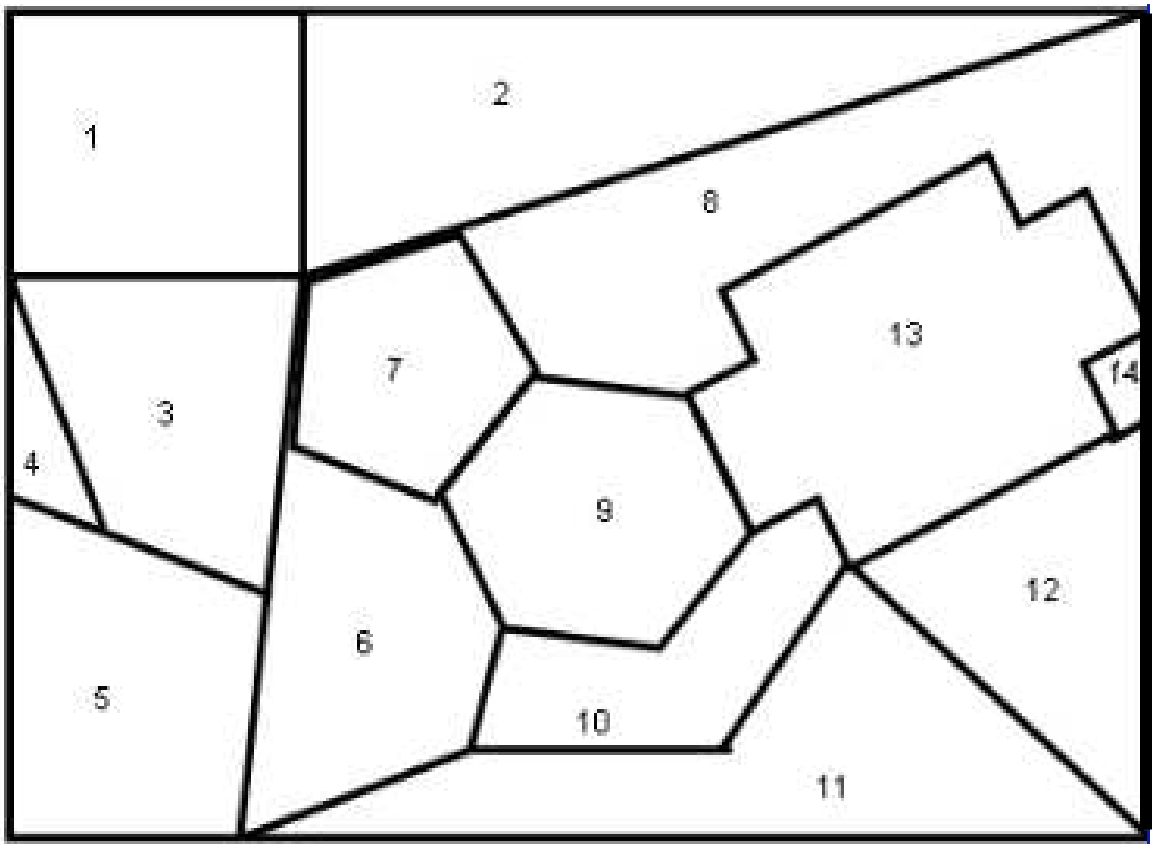


Irregular Polygons

An irregular polygon is not a regular polygon. It is a polygon whose sides are not all the same length or whose interior angles do not have the same measure.



Capture the Polygons



- You will need:
  - "Capture the Polygons" for each player
  - Crayons/markers/colored pencils
  - "Capture Cards"

- Rules:
  - The youngest player will choose first and then continue clockwise.
  - The first player will choose a "Capture Card." Then, he/she will read the clue aloud and color a polygon that matches the clue. For Example: This polygon has one pair of parallel sides. The player could color a trapezoid. If a polygon cannot be colored, play continues to the next player. Place the card at the bottom of the pile.
  - The winner is the first to capture (color) all of their polygons.

Capture Cards

Capture the polygon that has two parallel sides.	Capture the polygon that has no sides that are the same size.
Capture the polygon that is a decagon.	Capture the polygon that is a regular polygon.
Capture the polygon that is an irregular polygon.	Capture the polygon that has at least one right angle.
Capture the polygon that is a quadrilateral.	Capture the polygon that has at least two acute angles.
Capture the polygon that has an obtuse angle.	Capture the polygon that has ALL right angles.
Capture the polygon that is a pentagon.	Capture the polygon that is a hexagon.
Capture the polygon that is a heptagon.	Capture the polygon that has 2 pairs of parallel sides.
Capture the polygon that is a scalene triangle.	Capture the polygon that is an irregular quadrilateral.

Poly Assessment **Name _____**

1. Poly found a three-sided cracker. Two sides are the same length. What polygon best describes the shape of the cracker? _____

2. In the space below, draw one of the quadrilaterals you learned about and write 3 properties that describe this polygon.

Poly has a new cage that is shown below.

Part A. Classify the shape of Poly's cage. _____

Part B. Explain how you classified the shape of Poly's cage. Use what you know about polygons in your explanation. Use words, numbers, and/or symbols.

_____

_____

_____

_____

_____